Space Weather Technical Forecast

Issued on Saturday, 11 December 2021 at 00:27 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No Significant Activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity remained Very Low over the past 24 hours, with no significant X-ray flares recorded. There are no sunspots currently on the visible disc. No Earth-directed Coronal Mass Ejections (CMEs) were in evidence in available satellite imagery over the period.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was at Background levels, with the solar wind speed mostly showing an overall slight decline from 325km/s to near 300km/s by the period's end, but with a late kick recovering the lost ground. The solar wind density, meanwhile, showed a rising trend, from mid-single figures to exceed 30ppcc over the same interval. This rise in density was also accompanied by a rise in the magnitude of the IMF, peaking at 9nT with a north-south component varying between +/-4nT. This may be related to a Solar Sector Boundary Crossing (SSBC) or perhaps a CIR (possibly leading CH30/+ should the phi angle change), with the phi angle starting the period away from the sun (positive) but changing to mainly negative from after 10/1400UTC. The net result of the above solar wind measures was Quiet geomagnetic activity throughout, with a provisional peak 3-hourly Kp of 2- in the 21-24UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels.

The high energy electron flux (greater than 2 MeV) remained on a slightly increased diurnal variation between Moderate to High, with peak of 2750pfu at 10/1545UTC. The associated 24-hour integrated fluence is now only very narrowly below the Active threshold (1e8 integrated pfu), with the slightly increasing trend taking the 11/0000UTC observation to 9.02e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to stay Very Low in the period given the absence of front-sided sunspots.

Solar Wind / Geomagnetic Activity: A weak CME from a filament lift off on 06 December has now most likely passed Earth, although there is an outside chance of Active geomagnetism early on day one, Saturday 11 December. This is the only transient in the forecast.

A weak fast wind enhancement is otherwise possible on day one (CH30/+), contributing to the risk of Active intervals, but otherwise solar winds are expected to persist at background levels until the potential arrival of a new coronal hole on day four, Tuesday 14 December. By this time a (in a peak risk for the period) Chance of G1 is possible from CH32/-.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is

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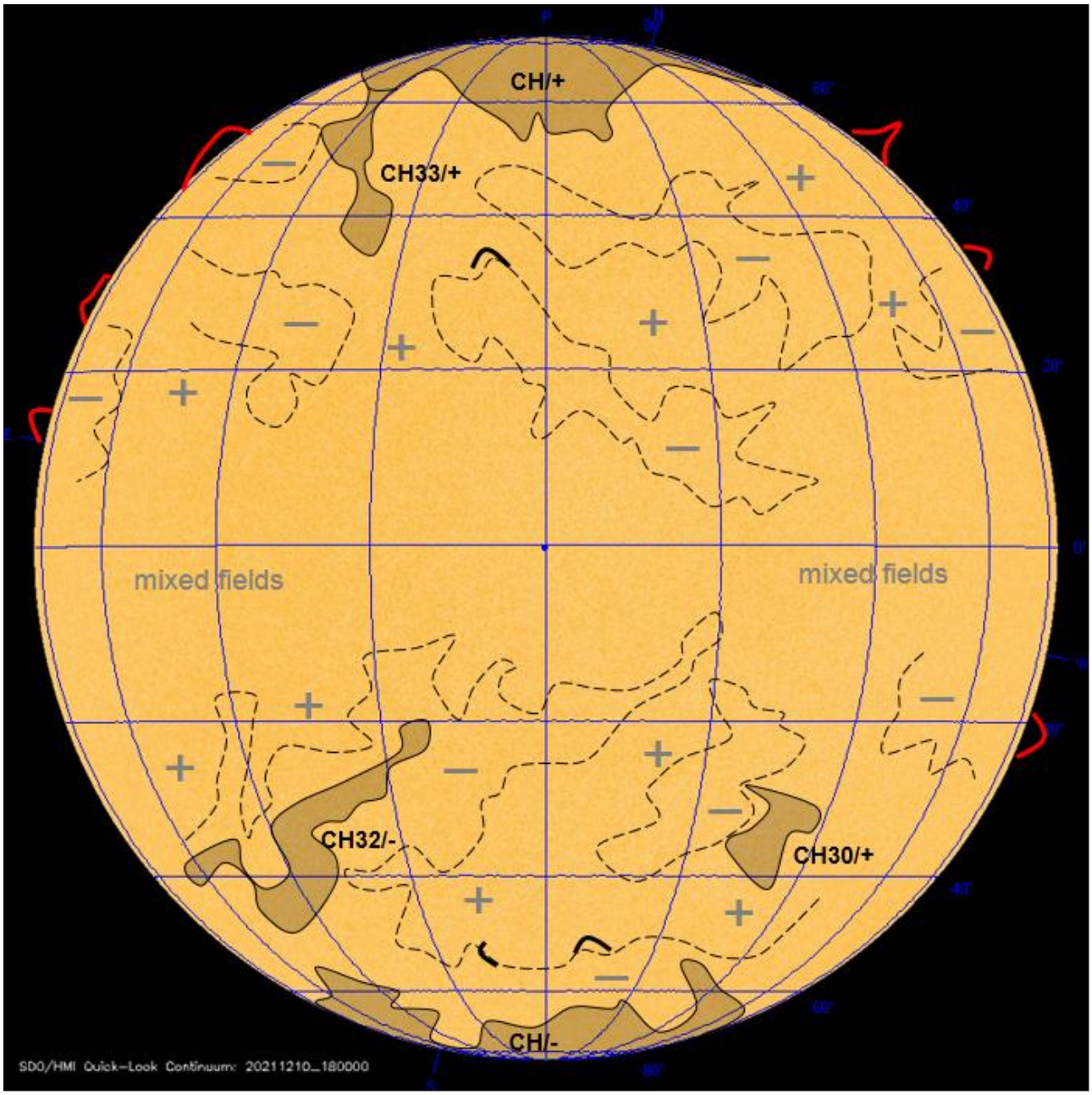
expected to remain at Background levels.

The high energy electron flux (greater than 2 MeV) is likely to continue varying between Moderate and High levels, with the associated 24-hour integrated fluence expected to remain very marginal for exceeding the Active threshold.

Figure 1. Solar Analysis Valid 10/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is still the potential for a weak CME originating from a filament eruption on 06 December to move across Earth at the very start of this four-day period, although on balance this has now most likely passed 1AU to no definite effect at Earth. This is the only transient in the forecast, and perhaps offers a brief Slight Chance of Active intervals.

Coronal hole 30 may serve to bolster this risk of Active intervals on day one from its position on the southwestern disc. This is a small feature, and new to this rotation, with only a slight enhancement expected. There should then follow a lull in activity until the potential arrival of recurrent coronal hole 32 at the end of the four days. This feature has retrogressed on the disc since its last pass, as well as appearing areally less extensive. These points, taken with the fact that coronal holes of any polarity are near their semi-annual minimum potency at this time of year, should help mean that the previous outing's Kp 5- and 600km/s wind should be more muted on this occasion, perhaps offering a 25% Chance of G1

Geomagnetic activity is forecast to be mainly Quiet, with the four days bookended by a Slight Chance of Active from any residual CME influence and CH30/+ on day one, and a Chance of G1 on day four from CH32/-.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	25
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
06/1313	Partial	Filament	SE Quadrant	310km/s	Overdue	Now likely missed

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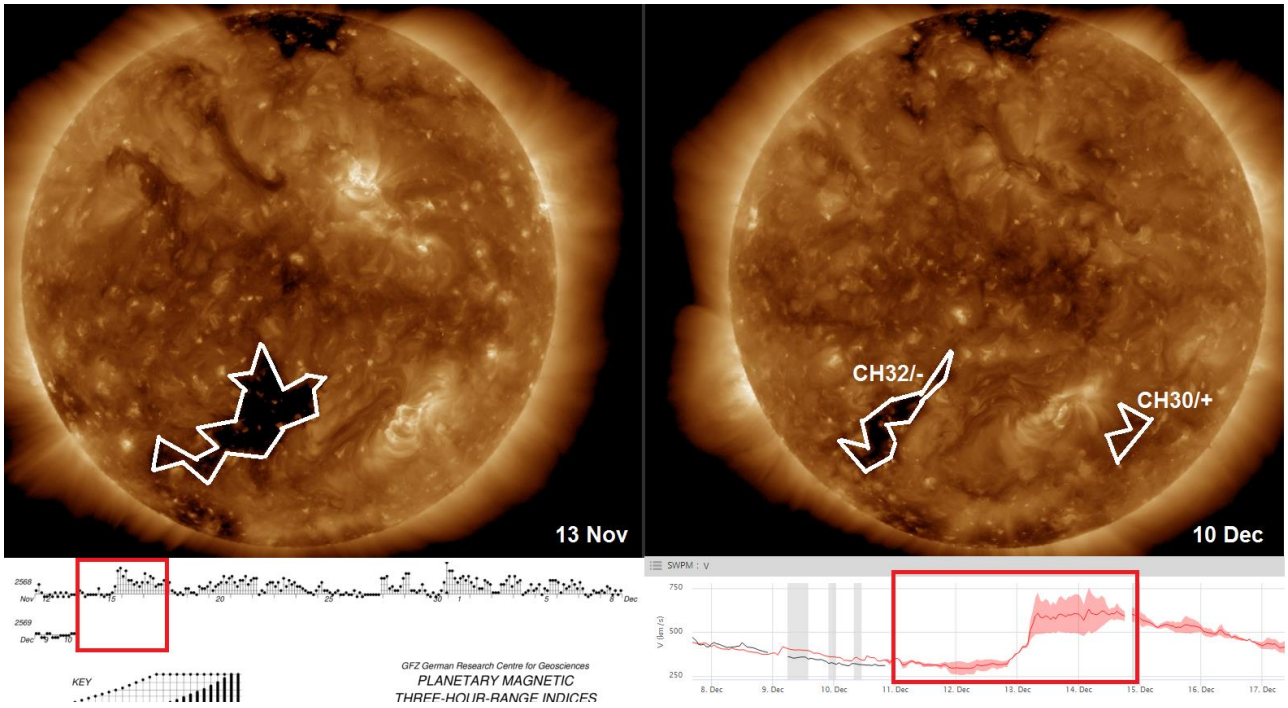
Figure 2: AIA 193 imagery from the previous rotation (upper left) and current, showing the relative decrease in size and retrogression of CH32/+. Geomagnetic activity and solar wind speeds are therefore thought less likely to match previous highs shown below (Bartels Kp and MOSWOC SWPM), with the peak also likely to fall relatively later in the four days.



Radio Blackouts - X-Ray Flares:

Solar Activity has been at Very Low levels during the past 24 hours. There are currently no sunspot regions on the visible disc, with activity anticipated to persist at Very Low levels for the remainder of the UTC weekend and perhaps beyond.

A bright region of flux is visible on STEREO A EUVI imagery, which may arrive on the Earth-facing side on days two or three (12 or 13 December). Whilst it is uncertain that this region will contain any notable spots, this may bring a Chance of activity increasing to Low.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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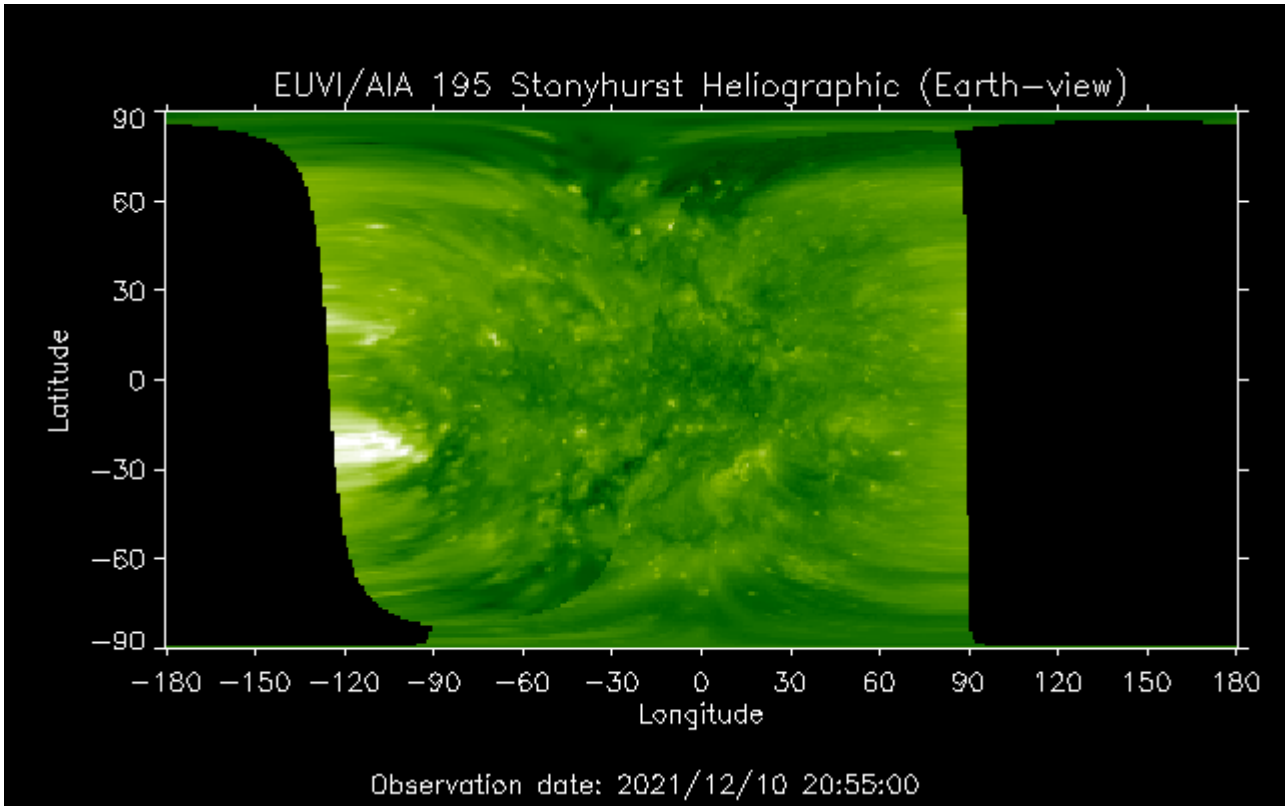
Figure 3: Cylindrical projection of the sun in extreme UV, showing a large bright flux region narrowly over the southeastern limb.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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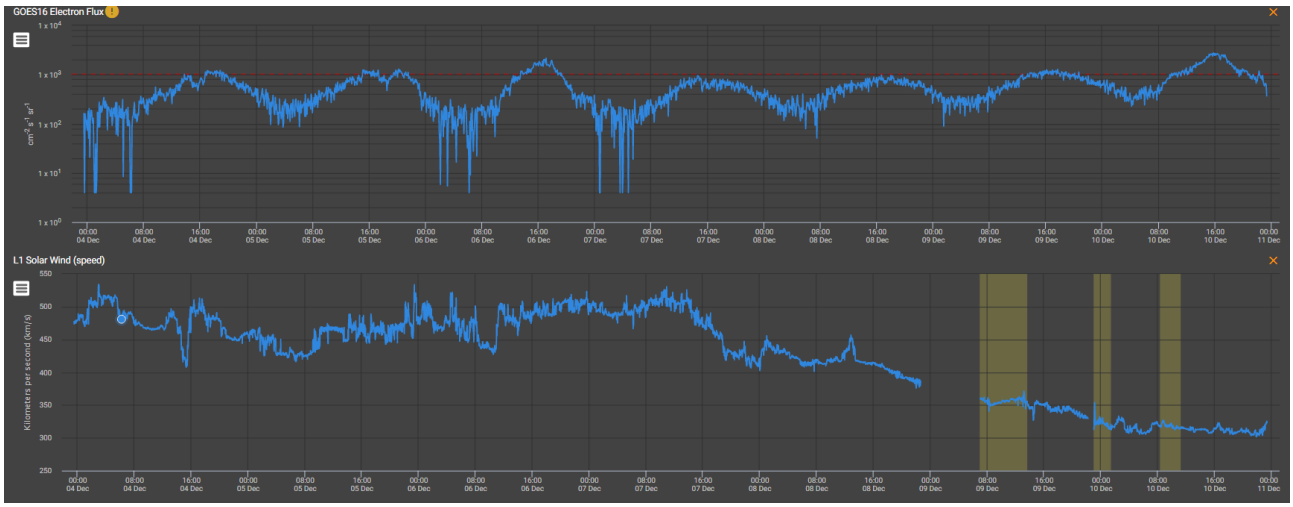
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16, is currently ranging between Moderate and High, with a slightly increased average relative to past days across the diurnal cycle. While the magnitude of any further increases should be very modest, its proximity to the Active fleunce threshold makes this relatively more likely to be achieved until any more decisive geomagnetic activity arrives, probably from CH32/- on day four.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	30	30	20	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: The past week in high energy (greater than 2MeV) electrons at GOES 16 (above) and the associated L1 solar wind speed (DSCOVR and ACE (the latter in yellow shading)). Note that the recent decline in solar wind and associated geomagnetic activity has allowed a day-on-day increase in flux levels, with this trend now likely to be nearing equilibrium.



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